

Remarks

Pending in the application are claims 1-30, of which claims 1, 4, 15, 16, 19 and 30 are independent. The following comments address all stated grounds for rejection, and the Applicant respectfully submits that the presently pending claims, as identified above, are now in a condition for allowance.

Rejection of Claims 4-13 and 15-30 under 35 U.S.C. §102

Claims 4-13 and 15-30 are rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,502,110 ("Houldsworth"). Applicant respectfully traverses the rejection for the following reasons.

Claims 4-13, 15, 19-28 and 30

The invention of independent claims 4 and 15, at least in part, determines a value indicative of a number of references to the candidate object from other objects in the object-oriented environment, and a value indicative of a number of cyclic paths including the candidate object. The invention controls the disposition of the candidate object on the basis of a predetermined relationship between the values. Claims 19 and 30 are medium claims that parallel claims 4 and 15, respectively.

Applicant submits that the Houldsworth fails to disclose that *the disposition of a candidate object is controlled on the basis of the predetermined relationship between the second value (the number of internal references in claims 15 and 30) and the third value (the number of cyclic paths in claims 15 and 30)*, as recited in claims 4, 15, 19 and 30.

The Houldsworth relates to a method and apparatus for reclaiming memory space allocated to data structure. Houldsworth discloses a combination of a first (mark-sweep) system and a second (reference-sweep) system where cycles of the first system are interleaved with cycles of the second system. In Houldsworth, the first system traverses the data structure and identifies objects to which no references are made by other objects. Houldsworth reclaims the

memory allocated to the identified objects. See, Houldsworth, Column 2, lines 28-40. The second system determines objects that are not descendents of root objects. Houldsworth reclaims the memory allocated to the objects that are not referenced by root objects. See, Houldsworth, Column 2, lines 41-46.

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In comparison, the claimed invention controls the disposition of the candidate object on the basis of the predetermined relationship between the number of the internal references to the candidate object and the number of cyclic paths including the candidate object. For example, in an illustrative embodiment described with reference to Figures 4A and 4B of the present application, the candidate object is destroyed if the number of the internal references to the candidate object is equal to the number of cyclic paths including the candidate object. Houldsworth does not disclose the usage of both the number of the internal references to the candidate object and the number of cyclic paths including the candidate object to destroy the candidate object. Houldsworth does not disclose that the disposition of a candidate object is controlled on the basis of the relationship between the number of the internal references to the candidate object and the number of cyclic paths including the candidate object, as recited in the claimed invention.

The Examiner asserts in the Office Action that that the cycles of the first system or the second system in Houldsworth correspond to the cyclic paths of the claimed invention. See the Office Action, page 3, line 15-20. The Examiner also asserts that “[t]he data structure traversed is the cyclic path representing a chain of references between objects and therefore the reachability relationships.” See the Office Action, page 10, line 12-14. Applicant respectfully disagrees with the Examiner’s assertion.

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In the present application, the term “cyclic path” refers to “a strongly connected component having the additional properties that: no node within the strongly connected component has an external reference; and no node within the strongly connected component is connected, either directly or indirectly, to an object having an external reference.” See the specification of the present application, page 7, lines 25-29. The strongly connected component refers to a path that starts and returns to the same object in graph theory. See the specification of the present application, page 7, lines 23-25. Figures 4C-4F illustrate an exemplary method for

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counting the number of cyclic paths to a candidate object. For the candidate object being considered for destruction, the cycle-detector (16 in Figures 1-3 of the present application) determines the number of cyclic paths to that object and compares that number with the number of internal references to that object. On the basis of this comparison, the designation process (14 in Figures 1-3 of the present application) designates that candidate object for either destruction or preservation.

In Houldsworth, the cycles of the first or second system are program or process cycles for traversing data structure and reclaiming memory space allocated to data objects in the data structure. The cycles of the first or second system in Houldsworth are not the cyclic paths described in the specification of the present application. Moreover, Houldsworth does not disclose that the data structure includes the cyclic paths of the claimed invention. Applicant submits that the term “cyclic path” recited in the claims should be constructed in terms of the definition described in the specification. *Phillips v. AWH Corp.*, 376 F.3d 1382, 71 USPQ2d 1765 (Fed. Cir. 2004).

In light of the aforementioned arguments, Applicant respectfully submits that the Houldsworth fails to disclose each and every element of independent claims 4, 15, 19 and 30. Applicant therefore requests the Examiner withdraw the rejection of claims 4-13, 15, 19-28 and 30 under 35 U.S.C. §102(e), and pass the claims to allowance.

Claims 16-18 and 29

The invention of independent claim 16 determines a first value indicative of a number of references to a candidate object that are not references from other objects in the object-oriented environment. The invention also determines a second value indicative of a number of references to the candidate object from other objects in the object-oriented environment, and a third value indicative of a number of cyclic paths including the candidate object. The invention controls the disposition of the candidate object on the basis of the first, second and third values. Claims 17, 18 and 29 depend from claim 16.

Applicant submits that the Houldsworth fails to disclose that *the disposition of the candidate object is controlled on the basis of the first value, the second value and the third value*, as recited in claim 16. The Examiner deems claim 16 as a computer-medium version of claim 15. See the Office Action, page 5, lines 7-9. Claim 16 parallels claim 1, and
5 recites different limitations than claim 15. Houldsworth does not disclose that the disposition of a candidate object is controlled on the basis of the number of references to a candidate object that are not references from other objects in the object-oriented environment, the number of references to the candidate object from other objects in the object-oriented environment, and the number of cyclic paths including the candidate object, as recited in
10 the claimed invention.

In light of the aforementioned arguments, Applicant respectfully submits that the Houldsworth fails to disclose each and every element of independent claim 16. Applicant therefore requests the Examiner withdraw the rejection of claims 16-18 and 29 under 35 U.S.C.
15 §102(e), and pass the claims to allowance.

Rejection of Claims 1-3, 11-14, 17, 18 and 26-28 under 35 U.S.C. §103

Claims 1-3, 11-14, 17, 18 and 26-28 are rejected under 35 U.S.C. §102(e) as being
20 unpatentable over U.S. Patent No. 6,502,110 (“Houldsworth”) in view of the garbage collection techniques (“Wilson”) disclosure in the background section of Houldsworth. Applicant respectfully traverses the rejection for the following reasons.

The invention in independent claim 1 determines a first value indicative of a number
25 of references to a candidate object that are not references from other objects in the object-oriented environment. The invention also determines a second value indicative of a number of references to the candidate object from other objects in the object-oriented environment, and a third value indicative of a number of cyclic paths including the candidate object. The invention also controls the disposition of the candidate object on
30 the basis of the first, second and third values. Claims 2-3 and 14 depend from claim 1. Claims 11-13 depend from claim 4. Claim 17 and 18 depend from claim 16. Claims 26-28 depend from claim 19.

Applicant submits that Houldsworth and Wilson fail to teach or suggest that *the disposition of the candidate object is controlled on the basis of the first value, the second value and the third value*, as recited in claims 1 and 16, and that *the disposition of the candidate object is controlled on the basis of the relationship between the second value and the third value*, as recited in claims 4 and 19.

The Examiner cites Wilson to provide teachings for the limitation of references to the candidate object that are not references from other object in the object-oriented environment. Wilson, however, does not teach determining a value indicative of the number of cyclic paths including the candidate object and utilizing the value to control the disposition of the candidate object. Wilson does not teach the cyclic paths of the claimed invention.

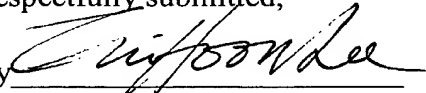
In light of the aforementioned arguments, Applicant respectfully submits that the Houldsworth and Wilson fail to teach all of the limitations of independent claims 1, 4, 16 and 19. Claims 2-3, 11-14, 17, 18 and 26-28, which depend from one of claims 1, 4, 16 and 19, are not rendered obvious over the cited prior art reference. Applicant therefore requests the Examiner withdraw the rejection of claims 1-3, 11-14, 17, 18 and 26-28 under 35 U.S.C. §103(a), and pass the claims to allowance.

Conclusion

In view of the above, each of the presently pending claims in this application is believed to be in condition for allowance. Accordingly, the Examiner is respectfully requested to pass
5 this application to issue. If, however, the Examiner considers that further obstacles to allowance of these claims persist, we invite a telephone call to Applicant's representative.

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Respectfully submitted,

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